

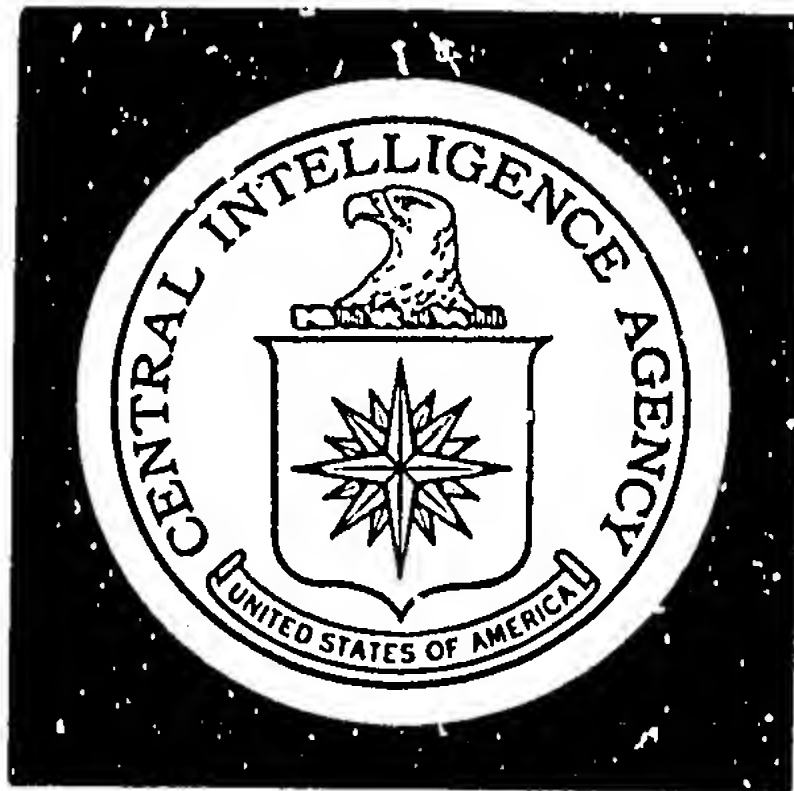
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DIRECTORATE OF
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Intelligence Memorandum

North Korea: The Status Of The Iron And Steel Industry

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence
August 1971

INTELLIGENCE MEMORANDUM

NORTH KOREA: THE STATUS OF THE IRON
AND STEEL INDUSTRY

Introduction

1. The rapid development of the iron and steel industry is a central feature of North Korea's industrialization program. Twice destroyed by war in the last three decades, the iron and steel industry has been rebuilt and expanded. Soviet equipment and technical assistance have played a key role in its reconstruction and remain a crucial factor in its continued progress. As for other inputs into the industry, iron ore and hydroelectric power are plentiful, and the level of technical skill of the populace is among the highest in Asia. North Korea lacks metallurgical-grade coking coal, however, and has primarily relied on Communist China for its supply. The increasing size and complexity of the industrial sector of the North Korean economy are resulting in a continued rise in demand for iron and steel products, in terms of both physical output and quality of product.

2. This memorandum discusses the development, the current physical facilities, and the productive capacity of North Korea's iron and steel industry. It describes the volume and character of trade in iron and steel products. And lastly, it examines the problems and explores the prospects for continued growth in the industry over the period of the new Six-Year Plan (1971-76).

Discussion

Background

3. Recent radio announcements from P'yongyang have claimed that North Korea now ranks among "the civilized nations of the world in the

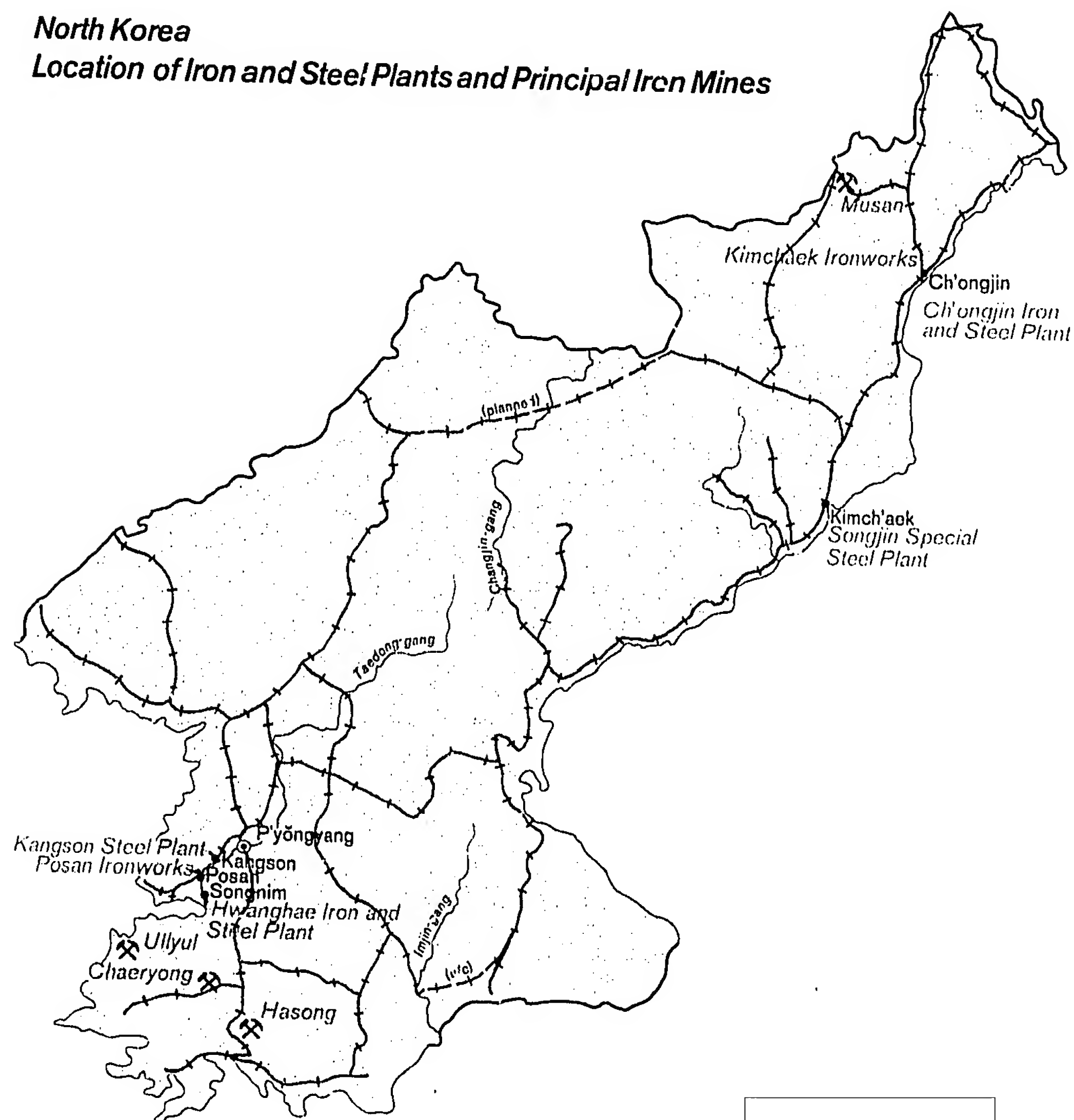
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North Korea
Location of Iron and Steel Plants and Principal Iron Mines



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per capita output of crude steel." According to official figures, per capita production of steel was 158 kilograms (kg) in 1970. This puts North Korea ahead of Communist China and South Korea with 20 kg and 16 kg, respectively, but leaves it far behind Japan with its 900 kg per capita.

4. In evaluating the North Korean iron and steel industry, the year 1970 is important because it marks the completion of the extended Seven-Year Plan for economic development (1961-70). 1/ The decade of the 1960s was one of substantial, although troubled, expansion for the North Korean economy, with output of crude steel growing at an average rate of 13% from its small 1960 base (see Table 1). During the new Six-Year Plan (1971-76), the government hopes to raise output to 3.8 million tons 2/ at a minimum, or at an average annual rate of 9-1/2% above the 2.2 million tons of 1970.

5. The first ironworks in North Korea was constructed on the site of the present Hwanghae plant in 1919 by the Japanese, who occupied Korea from 1905 to 1945. By 1945, three more plants had been built, at Ch'ongjin, Kangson, and Kimch'aek. These plants suffered heavy damage in the Korean conflict.

6. By 1960, after two economic plans and extensive Soviet assistance, the iron and steel industry had begun to play a key role in the North Korean economy. There were difficulties, however, which the Fourth Congress of the Korean Workers' Party proposed to alleviate in the Seven-Year Plan. One of the main problems was the geographic separation between pig iron production, located primarily in the northeast, and crude and rolled steel production, located in the southwest. Under the new plan, this geographical imbalance was to be evened out. Especially ambitious plans were made for Ch'ongjin in the northeast, which was to become the largest completely integrated iron and steel plant in North Korea. Another problem was the lack of variety in alloy and structural steel product mix.

Expansion, 1960-70: An Overview

7. The original Seven-Year Plan for 1961-67 fell short of its goals and was extended for three additional years, through 1970. Even so, the expansion of the iron and steel industry in the 1960s was impressive, as



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2. *Metric tons are used throughout this memorandum.*

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Table 1

North Korea: Iron and Steel Production

	Million Metric Tons				
	<u>1960</u>	<u>1964</u> <u>a/</u>	<u>Seven-Year</u> <u>Plan Goals</u>	<u>Estimated</u> <u>Production</u> <u>1970</u>	<u>Six-Year</u> <u>Plan Goals</u>
Iron ore	3.11	4.00	7.2	6-7	11-12
Pig and sponge iron	0.87	1.34	2.20 <u>b/</u>	2.00	3.50 <u>b/</u>
Pig iron	0.75	1.15	N.A.	1.55	2.70
Sponge iron	0.12	0.19	N.A.	0.45	0.80
Crude steel	0.64	1.13	2.20 <u>b/</u>	2.20 <u>c/</u>	3.80 <u>b/</u>
Rolled steel	0.47	0.86	1.60 <u>b/</u>	1.2-1.6	2.80 <u>b/</u>

a. The 1964 production data on iron and steel were the last complete figures to be announced by North Korea.

b. These figures are the minimums of a range originally released by the regime.

c. The figure for crude steel is the only one released for 1970.

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a comparison of facilities at the beginning and end of the decade indicates. In 1960, there were three coking batteries, two large blast furnaces, nine open hearths, three Bessemer converters, 16 electric furnaces (most of them small), and several reconstructed blooming and rolling mills of Japanese vintage. In addition, there were six Krupp-Renn rotary furnaces for the production of sponge iron. In contrast, by late 1970 North Korea boasted a total of four coking batteries, as well as four large, three medium, and five small blast furnaces; 11 open hearths; and 28 electric furnaces. One iron ore sintering line was operating, with another near completion. The Bessemer shop had been replaced by three basic oxygen furnaces. Air separation plants to provide oxygen had been installed, and several new blooming and rolling mills were in operation. Twelve rotary furnaces for sponge iron were in operation; of these, four had been installed at a new plant near Posan, six kilometers south of the Kangson Steel Plant.

Problems

8. The iron and steel industry shared in the difficulties caused by the reduction in Soviet assistance upon which the success of the Seven-Year Plan depended. The first intimation of trouble in iron and steel came in 1964 when North Korea approached the Austrian firm of Voest regarding the purchase of basic oxygen and continuous casting equipment, which the USSR had originally agreed to install in Ch'ongjin as part of a technical assistance package. These negotiations broke down when it became apparent that the USSR would not provide long-term loan guarantees for the North Koreans. In 1966, continued trouble in the steel industry was evidenced by a failure to increase investment at the rate called for by the Seven-Year Plan. It was in 1966 that the government was forced to extend the Plan to 1970.

9. A reconciliation with the USSR was effected by 1966, and general assistance was soon resumed. Nevertheless, it was not until 1968 that there was a noticeable speedup of construction efforts in the iron and steel industry. Even so, a rolling mill begun in 1963 and four blast furnaces begun subsequent to 1965 remained incomplete by 1970, with construction apparently suspended. The general economy, including the iron and steel sector, no doubt suffered from the diversion of funds to a sizable military modernization program which began soon after the reconciliation with the USSR in 1966.

ProductionCrude Steel

10. According to North Korean announcements, the production of crude steel in 1970 matched the minimum Seven-Year Plan goal of 2.2

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million tons. It represents more than a tripling of production since 1960 (see Table 1). Hwanghae Integrated Iron and Steel Plant is the only individual facility whose output for 1970 was released; according to a radiobroadcast, Hwanghae produced 34% of total production in 1970. Estimates for the remaining plants are based mainly on estimates of their capacity. Table 2 gives the breakdown of production by plants for 1960 and 1970.

11. Much of the expansion in productive capacity in the 1960s took place at Ch'ongjin, whose share of total output increased from 13% to 39%. Hwanghae now trails Ch'ongjin in importance and is the only plant producing steel by the open hearth method. The Songjin and Kangson plants together probably accounted for approximately 27% of the 1970 output of crude steel. Both use electric furnaces. At Kangson, six electric furnaces were added to the six operating prior to the Plan. In addition, a large electric furnace building containing four furnaces was constructed, but as of late 1970 reportedly was not yet operating. Two electric furnaces were installed at Songjin early in the plan period. Songjin produces most of North Korea's high-quality and alloy steels.

12. The most dramatic development has been the introduction of the basic oxygen process, in which oxygen is injected at high pressure into a bath of molten iron. Table 3 illustrates the evolution in technology since 1960. Three basic oxygen furnaces were in operation at Ch'ongjin in late 1970 and apparently represent modifications to existing 60-ton side-blown Bessemer converters. This type of furnace increases significantly both the capacity and the efficiency of the steel-making process at Ch'ongjin. The injection of oxygen into open hearth and electric furnaces had apparently become common by the end of the Plan. An interesting development is the relative decline of electric steel making. Much hope had been expressed for this method prior to the Seven-Year Plan. The reason for the decline is not clear, but the scarcity of raw material in the form of scrap and sponge iron may be a factor. An equally significant obstacle could have been the shortage of electric power. Delays in the construction of the Soviet-assisted Puk'chang Thermal and Sodu-su Hydro Powerplants may have been involved.

Rolled Steel

13. To judge from the regime's silence, the target of 1.6 million tons of rolled products was not reached in 1970. Only 1.04 million tons of rolled steel were reportedly produced in 1969, and 1970 production was probably in the range of 1.2 to 1.6 million tons. The government did supply one specific figure for 1970 - that the Hwanghae plant produced 607,000 tons of rolled steel, which would amount to 40% to 50% of total production.

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Table 2

North Korea:
Estimated Distribution of Crude Steel Production

	<u>1960</u>		<u>1970</u>		<u>a/</u>
	<u>1,000 Metric Tons</u>	<u>Per- cent</u>	<u>1,000 Metric Tons</u>	<u>Per- cent</u>	
Ch'ongjin	82	13	860	39	
Hwanghae	265	41	740	34	
Songjin	134	21	300	14	
Kangson	160	25	300	14	
<i>Total</i>	<i>641</i>	<i>100</i>	<i>2,200</i>	<i>100</i>	

a. Because of rounding, components may not add to the totals shown.

Table 3

North Korea:
Dependence on Four Different Steel-Making Methods

	<u>1960</u>	<u>1970</u>
	<u>Percent</u>	
Open hearth	41	34
Electric	46	27
Bessemer	13	2
Basic oxygen	0	37

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Since the Ch'ongjin plant possessed no rolling facilities in 1970, the balance was produced at the Kangson and Songjin steel plants.

14. The plants at Hwanghae, Songjin, and Kangson all benefited from major additions to rolling capacity in the period of the Seven-Year Plan. One disappointment was the postponement of a continuous casting facility projected for Ch'ongjin by the end of the plan period. This project was a casualty of the quarrel with the Soviets. According to *Pravda* of 15 August 1970, however, installation was at last under way. The continuous casting process eliminates the costly reheating of ingots before blooming and provides a higher crude to bloom yield than is obtained by the ingot-blooming method. A second disappointment in the plan period was the suspension of construction of the finishing mill begun at Songjin in 1963.

Pig and Sponge Iron

15. North Korea failed to announce a figure for pig and sponge iron production in 1970. An estimate of production based on domestic requirements and exports suggests that production fell somewhat short of the target. Since about 500,000 tons of scrap was required to produce 2.2 million tons of steel, given the technology employed in North Korea, it is apparent that about 1.7 million tons of pig and sponge iron were needed domestically. To this may be added approximately 300,000 tons of pig iron exported in 1970. Consequently, 2.0 million tons of pig and sponge iron combined were probably produced during the final year of the Seven-Year Plan. Of this total, about 450,000 tons was sponge iron produced at Kimch'aek and Posan. The regime announced that 765,000 tons of pig iron were produced at Hwanghae, leaving 785,000 tons of pig iron produced at the Ch'ongjin plant (see Table 4).

16. Blast furnace capacity expanded rapidly in the Seven-Year Plan period and currently exceeds North Korea's needs. Most of the expansion took place at Ch'ongjin, whose capacity in 1970 was roughly 1.7 million tons - more than double actual production. Smaller additions to capacity were made at Hwanghae, which also operated below capacity in 1970. At Ch'ongjin, the original two large blast furnaces were enlarged early in the Seven-Year Plan, and three medium-size blast furnaces were installed subsequent to 1965. At Hwanghae, one large and five small blast furnaces were built to supplement the large one in existence prior to 1960. Construction has apparently been suspended on two other large blast furnaces at Hwanghae and on two other small furnaces at Ch'ongjin.

17. The employment of Krupp-Renn rotary furnaces in North Korea represents an important feature of the iron and steel industry. In 1960

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Table 4

North Korea:
Distribution Among Plants of Sponge
and Pig Iron Production

Thousand Metric Tons		
Plant	1960	1970
Sponge iron		
Kimch'aek	120	300
Posan	--	150
Pig iron		
Hwanghae	225	765
Ch'ongjin	512	785
Total	870 <i>a/</i>	2,000

a. Including about 13,000 tons of pig iron produced experimentally in electric blast furnaces.

this process accounted for 14% of iron output, and by 1970 for more than 22%. Although the Krupp-Renn process has been tried and abandoned in most parts of the world, conditions in North Korea render this an attractive and useful method. Primary considerations supporting its use are the high silica content of the Musan mine ores and the ability of the rotary furnaces to utilize native anthracite coals. The product of the Krupp-Renn process -- sponge iron -- is also extremely useful in supplementing scrap as a feed for the electric furnaces at the Kangson and Songjin steel plants. Expansion at the Kimch'aek plant occurred early in the plan, with two rotary furnaces added to the six already in place. At the new Posan plant, four rotary furnaces were completed in 1969-70.

Raw Materials

Iron Ore

18. Iron ore production in North Korea in 1970 is estimated at about 6-7 million tons before beneficiation. According to North Korean reports, approximately 4.0 million tons of this comes from the Musan mine in the

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northeast. The remainder is taken from mines located at Chaeryong, Hasong, and Ullul in the southwest section of North Korea. The regime claims also to have developed a new mine near the demilitarized zone. The investment figures for the Seven-Year Plan suggest that great efforts went into improvements in the mining sector. Ore processing has no doubt been enhanced, as new beneficiation facilities have been reported at Musan, and new iron ore sintering lines have been installed at both Ch'ongjin and Hwanghae. In addition, the double-tracking and electrification of the rail line connecting Musan and Ch'ongjin has facilitated the transport of ore from mine to mill. The output of the Musan mine in 1970 was more than the nearby Ch'ongjin and Kimch'aek plants could absorb, with the excess being shipped to the southwestern plants. Beneficiated ores moving to blast furnaces in North Korea are reported to be of average 55% iron content. The Musan ore concentrates, however, contain in addition approximately 35% silicious quartz not easily removed by mechanical means. These ores considerably reduce the efficiency of the blast furnaces in which they are used.

Coke

19. North Korea is estimated to have required approximately 1.2 million tons of coke in 1970. Coke capacity was adequate to produce this amount. By the end of the Seven-Year Plan, North Korea possessed four byproduct coking batteries - one more than in 1960. Two of these were located at Ch'ongjin and two at Hwanghae. About 1.9 million tons of coking coal is needed to produce 1.2 million tons of coke. North Korea has practically no coking coal of metallurgical quality and has until recently imported nearly all of its requirements from northern China. In 1967, at the height of the Chinese Cultural Revolution, supplies of coking coal were disrupted. The North Koreans were forced to construct several small blast furnaces at Hwanghae designed to utilize briquettes made of native anthracite. These furnaces were not very productive, it was reported, and it would have taken seven of them (only five were actually built) to equal the annual production of one large Hwanghae blast furnace. More important, North Korea turned to the USSR for substantial quantities of coke and coking coal in 1968-69.

20. Since the late 1950s the North Koreans have experimented with processes that would minimize the need for imported coking coal. The reduction of iron ore in an electric "blast furnace" was attempted, and the prediction was made that 1 million tons of pig iron would be produced in this manner by 1970. Other methods involved the blending of imported coking coal with domestic bituminous coals and with finely powdered iron ore to produce so-called "ferro-coke." By 1970, little was being heard of these techniques, and the only process known to have survived is the Krupp-Renn process.

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Trade

21. North Korean trade in iron and steel products increased from approximately \$34 million in 1961 to \$56 million in 1969 with those countries for which data are available (see Table 5). Expansion has taken place primarily in the export sector. By 1969, exports and imports of iron and steel products to the USSR and the Free World amounted to \$48 million and \$8 million and comprised 18% and 2%, respectively, of North Korea's total exports and imports with all countries. Japan is North Korea's predominant Free World market. The level of imports has not risen significantly since 1961. Most imported iron and steel products are obtained from the Soviet Union.

22. The pattern of trade with the USSR has been remarkably consistent since 1961. North Korea exports rolled steel products and imports primarily ferroalloys and specialized rolled steels and pipes. Prior to 1964, exports to the Free World were composed almost exclusively of pig iron. Since 1964 the value of exports to the Free World has been about equally divided between iron ore concentrates and sponge iron on the one hand and pig iron on the other. There have also been minor sales of ingots and bars of steel. Imports from the Free World have not increased since 1961 and consist largely of ferroalloys, sheet steel, and special pipes and structural shapes. North Korea enjoys an especially favorable position with respect to iron ore; it is adjacent to a vigorous and growing market in Japan and has earned considerable foreign exchange by exploiting this advantage. Although its imports of iron and steel products remain small, they represent purchases of highly essential goods for which North Korean productive capacity is limited or nonexistent.

23. Almost no hard information is available on trade between North Korea and Communist China. Because North Korea must pay for the coking coal it gets from China, it may be sending substantial quantities of its relatively plentiful pig iron to China. Some 400,000 tons of iron ore reportedly were shipped to China in 1966. In addition, China is known to have recently placed orders with Free World countries for substantial amounts of pig iron. Although there has been periodic trade in iron and steel products with other countries - especially the East European countries - such trade is irregular and minor.

Prospects

24. In 1970 the Fifth Congress of the Korean Workers' Party endorsed a new Six-Year Plan for the further development of the North Korean economy. The Plan contains some ambitious but not unrealistic goals for the iron and steel industry (see Table 1). By 1976, production of pig and sponge iron and of crude steel is to expand by approximately 75% over

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Table 5

North Korea: Trade in Iron and Steel Products with the USSR
and the Free World

	Million US \$			
	1961		1969	
	<u>Imports</u>	<u>Exports</u>	<u>Imports</u>	<u>Exports</u>
<i>Total trade</i>	174.0	160.0	385.0	272.0
Of which:				
Iron and steel trade	6.4	27.9	8.0	48.1
USSR	5.3	26.8	6.9	33.5
Free World	1.1	1.1	1.1	14.6

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the estimated 1970 level of production. The output planned for rolled steel products also represents at least a 75% increase over 1970. According to North Korean announcements, the Plan is off to a strong start, with capital construction funds allocated to the iron and steel sector 50% greater for 1971 than for 1970.

25. Most of the construction projects mentioned in the Plan have been under way for some time. Completion of the blast furnaces at Ch'ongjin and Hwanghae, as well as the installation of additional rotary furnaces at Posan, will provide more than enough capacity to satisfy the requirements of the Plan in pig and sponge iron. The new basic oxygen furnace shop at Ch'ongjin is to be completed. Its eventual capacity is claimed to be one million tons of steel. If this figure is correct, considerable expansion in crude steel production capacity must take place in other plants. The most likely candidate for such expansion is Hwanghae; by 1976, capacity to produce pig iron will have far outrun the capacity of present open hearth steel facilities at this plant. New rolling mills are projected and the continuous casting plant at Ch'ongjin is to be completed. Although not mentioned by the Plan, expansion of coking capacity will be necessary prior to 1976 or additional coke imports will be required. Other improvements called for by the Plan are qualitative in nature. Among the most important of these are plans to enhance the quality of iron ore and to raise the quality and increase the variety of special alloy steels.

26. Continued progress of the North Korean iron and steel industry is dependent upon Soviet assistance and upon supplies of Chinese coking coal. Recent purchases of coking coal from the USSR and from India are evidence of a desire to diversify sources. Nonetheless, North Korea's end-of-plan requirements for nearly 4.2 million tons of coking coal cannot be satisfied without large purchases from China. North Korea is dependent upon the USSR for technical assistance as well as for the continuous casting plant currently under construction and the new rolling facilities called for by the Six-Year Plan.

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27. [] negotiations with several West European firms suggest an attempt by North Korea to escape exclusive dependence upon the USSR for the provision of rolling mills. []

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Conclusions

28. Of the minimum Seven-Year Plan production targets for the iron and steel industry, North Korea is known to have achieved only that for crude steel. The only specific plants for which successes are claimed are Kangson and Hwanghae. From a broader perspective, however, progress in the iron and steel industry has been quite satisfactory. Production has increased substantially since 1960 and is adequate for domestic needs, with the notable exceptions of certain ferroalloys and special rolled steel products. Pig and sponge iron provide a case in point: although the end-of-plan target was not achieved, capacity in this area was more than adequate. Similarly, finishing capacity expanded considerably, and it seems that one of the regime's goals -- expansion of the varieties of rolled steel products -- has been satisfied. On the whole, substantial progress was made toward establishing a balance between the stages of production -- especially in northeast Korea. Some important changes in technology have taken place during the Seven-Year Plan period. Among the most significant is the use of oxygen in steel making -- particularly the employment of the basic oxygen furnace process at Ch'ongjin.

29. North Korea could not have attained its present position in iron and steel without the assistance of the USSR. The crucial role of Soviet aid is underlined by the fact that most shortfalls can be attributed to the cutoff of such aid between 1963 and 1966. The important Ch'ongjin plant was most directly affected. Not until late 1970 was the basic oxygen furnace shop believed to be operating, and the continuous casting plant was just being installed as of that date. The absence of a continuous casting facility is critical, and until it is rectified North Korea will lack needed primary rolling capacity. Another possible cause of shortfalls in the iron and steel industry is to be found in the reduction of deliveries of coking coal from China during the Cultural Revolution; Soviet deliveries of coke and coking coal may not have made up for the lower Chinese shipments. Finally, the military modernization program may have contributed to failure by diverting investment resources from the iron and steel sector.

30. Prospects for further development during the Six-Year Plan are favorable, providing that North Korea receives planned levels of Soviet and Chinese trade and aid and avoids diverting more of its scarce resources to military expansion. Soviet assistance in equipment and technology, as well as sales of Chinese coking coal, continue to be crucial factors in the progress of North Korea's iron and steel industry. In addition, trade relations with the Free World, especially with Japan, could evolve to the point where sophisticated technical assistance and equipment are made available to North Korea and thus lend impetus to the development of the iron and steel industry.

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